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(54) Communications device for motor vehicles for receiving selective information transmitted by a service center

(57) A data communications device comprises a locator unit of the satellite type (GPS), a transceiver that operates in the mobile-telephone frequency range (GSM,GPRS,UMTS), a short-range communications device for communication with local detectors (4), and a display for displaying information received over one or more of the receivers; by integrating these electronic components it is possible to receive selectively information sent by a service center (50) that is specific for each individual user and is selected according to the position currently occupied by the vehicle within the road network managed by an operator.

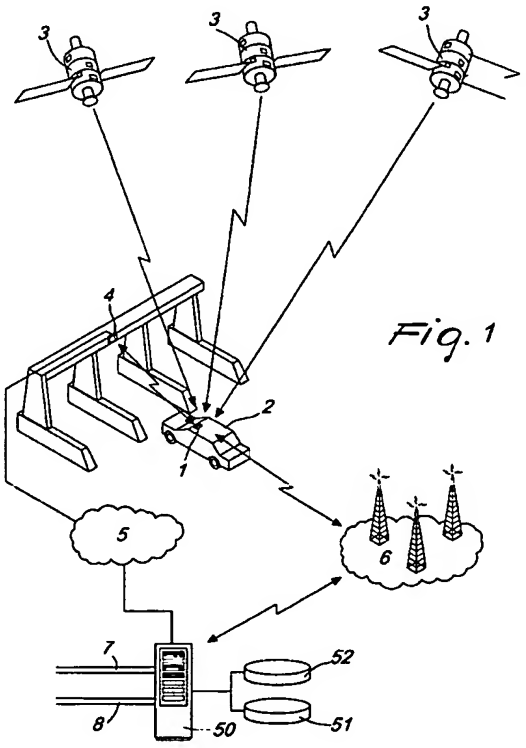

Fig. 1

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Description

[0001] The present invention generally relates to a road information system and more particularly to a device for motor vehicles capable of receiving and displaying information processed starting from different sources on the basis of data made available by known navigation systems and from information transmitted or resent toward a service center by said device.

[0002] Motor vehicle navigation systems, such as satellite navigation systems, are currently well-known and allow to determine precisely the position of the vehicle on which the navigation system is installed and to calculate easily the speed of said vehicle on the basis of the time spent to travel the distance between two points.

[0003] Current navigation systems are based on the so-called Global Positioning System or GPS, a system that uses a constellation of twenty-four NAVSTAR-GPS satellites owned by N.A.S.A., each of which transmits in broadcast mode, i.e., generically and not to a specific recipient, its position at every instant. Reception of the signal sent by at least three satellites allows to calculate the position of the receiver with great precision. It becomes therefore possible, by associating this information with a geographical map managed in electronic form by a computer, to display on a screen, in the context of said map, the position of the vehicle on which the satellite navigation system is installed and to provide the driver with road information for reaching a preselected destination.

[0004] It is known that road networks often have toll sections, the use of which entails paying a toll, which is usually calculated on the basis of the distance actually traveled by the vehicle. This occurs in particular in most highway networks in several countries, which are managed by an operator. Toll payment at the toll station is a cause of slow traffic and queues on highways, and therefore, as information technology and data communications have become widespread, fully automatic payment systems have been developed which allow drivers of vehicles to avoid stopping at the toll station as traditionally usually required in order to complete the transaction. These systems substantially comprise devices for detecting the transit of a vehicle which are located at highway toll stations and activate a communication with a corresponding communications device installed on board the vehicle in transit and are finally connected to a data communications network in order to send to a service center data that indicate the transit of the vehicle.

[0005] For the sake of simplicity in description, the device installed on board the vehicle is identified hereinafter by the expression "electronic pass": an example of this electronic pass is the Telepass™, which identifies the system currently used on the Italian highway network. Likewise, again for the sake of simplicity in description, the device installed at one or more gates of a highway toll station for detecting the presence of an electronic pass is identified hereinafter by the expression "local detector".

[0006] Thanks to the electronic pass, whenever a vehicle provided with said device transits in the vicinity of a gate of a toll station on which a local detector is installed, the local detector acquires a unique identification code of the electronic pass and transmits to the service center, over a data communications network, information related to the transit that has occurred. The central system then stores the data received according to an appropriate format in order to keep trace of the event and if necessary to calculate the amount due related to the road or highway section traveled, the toll of which is then charged automatically to the owner of the electronic pass.

[0007] Although the systems described above unquestionably provide several advantages to the user, they are however insufficient to meet the needs that arise from the current traffic situation. These systems in fact do not allow to provide vehicle drivers, even if they have installed both systems, with suitable information on traffic conditions or weather conditions related to the road or highway section on which the vehicles are about to travel. It is therefore necessary to resort to information transmitted periodically by appropriate authorities, usually by radio, in order to know the traffic conditions of the road section of interest. This entails an obvious inconvenience for the driver, due mainly to the fact that the information is necessarily sent in broadcast mode for all users of the road or highway network and therefore most of the information is of no interest for the recipient.

[0008] The aim of the present invention is to provide a communications system for motor vehicles that allows to send and receive information related to traffic, to the road section currently being traveled, to the travel cost and the like, that is of specific interest for the driver who receives that information and can be updated as the vehicle advances along its route.

[0009] Within this aim, an object of the present invention is to provide a communications system for motor vehicles that is integrated and allows to maintain and integrate the advantages provided by automatic toll devices and satellite navigation systems described above.

[0010] Another object of the present invention is to allow real-time updating of the information related to traffic or to the road section traveled, updating the data to be sent to each individual driver also on the basis of information that originates from the various devices installed on the different vehicles circulating on the roads covered by the local detectors.

[0011] This aim and these and other objects that will become better apparent hereinafter are achieved by a data communications device for motor vehicles, comprising a locator unit provided with a satellite signal receiver and with a receiver and a transmitter that operate in the mobile-telephone frequency range, a local communications device, which comprises a short-range transceiver for communication with local electronic de-

tectors, and a display for displaying information received over one or more of said receivers.

[0012] Conveniently, the satellite receiver can be a GPS-type receiver, the transceiver on mobile-telephone frequencies can be a transceiver of the GSM, GPRS or UMTS type, while the short-range receiver and transmitter is preferably a conventional transceiver used along road or highway networks that entail a toll, such as the Telepass™ electronic pass used on Italian highways. Local detectors are mainly located in fixed sites, typically road toll stations, but can obviously include any other dedicated site along the network managed by the operator.

[0013] The device according to the present invention can be provided advantageously with an additional receiver, typically of the infrared or radiofrequency type, but optionally also of the wired type, for acquiring commands sent by a control device that is driven by the user, for example a keypad or a remote control. By way of this device, the user can choose to send, over the transceiver which operates on the mobile-telephone frequencies and protocols, messages to the central system that indicate significant data that identify his position, for example the signals received by means of a satellite receiver or also descriptive signals entered via his keyboard.

[0014] Conveniently, such signals that identify the position of the vehicle can be sent automatically at regular intervals without user intervention.

[0015] Advantageously, the device according to the present invention can be provided with memory means for collecting data related to the average speed held by the vehicle on which it is installed and with means for comparing the average speed and an expected average speed that can be set remotely in order to calculate the traffic conditions in the section being traveled.

[0016] Further characteristics and advantages of the present invention will become better apparent from the following detailed description, given by way of non-limiting example and accompanied by the corresponding figures, wherein:

Figure 1 is a schematic view of the different components that provide information, sent in broadcast mode or targeted for each individual driver or group of drivers;

Figure 2 is a diagram of a data communications device for motor vehicles according to the invention;

Figure 3 is a flowchart that exemplifies the core of the operation of the system according to the invention;

Figures 4a-4e are views of some examples of information displayed on the display of the device according to the invention.

[0017] Figure 1 illustrates the components required for the correct operation of the motor vehicle communications device according to the present invention, such device being designated as a whole hereinafter by the expression "information pass". Figure 1 illustrates an information pass 1 that is installed on a motor vehicle 2. The information pass is capable of receiving information from a constellation of satellites 3, of receiving and transmitting information to a detector 4, typically installed at gates of road or highway stations, and is further capable of receiving and exchanging information with a service center 50 over a data communications network 5, which comprises a database 51, which stores temporarily or permanently information related to the position and/or speed of the motor vehicles, and a database 52, which stores information that is entered manually or automatically and originates from external data acquisition sources, for example traffic data acquisition centers, over a local connection 7 or a remote connection 8 or, finally, information that is calculated starting from the data sent by said information passes 1.

[0018] Figure 2 is a schematic view of the components of the information pass device 1. Such device substantially comprises three modules, which can be completely integrated together or can be delocalized inside the motor vehicle and appropriately connected to each other according to conventional methods. In particular, the information pass 1 comprises a locator unit 10, which is provided with a receiver 11 for receiving a signal that arrives from the satellites 3 and a decoder 12 for correctly decoding the received signals. The same module has a transceiver 13 for receiving and sending signals remotely, preferably with standardized frequencies and protocols, for example signals of the GSM, GPRS or UMTS type or any other conventional communications network. Likewise, an encoder/decoder (codec) 14 is associated with the interface 13 in order to correctly decode the received signals and correctly encode any output signals.

[0019] The module 10 is connected, by means of a connection 15 of any kind, for example an RS232 serial connection, to a module 20, which comprises an interface 21 for communication with the local detectors 4 of electronic passes; a corresponding codec 22 is suitably associated with said interface and is used for ordinary operations for encoding and decoding the received signal. The module 20 further comprises a processor 23 and a memory 24, in which a unique identifier of the device 20 is encoded. It should be noted that the term "processor", as well as the term "memory", are used here in a generic sense and represent both optional firmware used for advanced-mode management of the data flowing through the device and dedicated hardware circuits in the case of low-cost embodiments.

[0020] The module 20 comprises or is connected to a screen or display 28, which can display information under the control of the processor 23 or, as mentioned, of the corresponding electronic circuits.

[0021] Finally, the module 20 can be provided with an interface 25 and with a corresponding decoder 26 that is capable of receiving commands from a control device

27, for example a keyboard or a remote control.

[0022] The operation of the system, shown schematically and partially for the sake of clarity in the flowchart of Figure 3, is as follows.

[0023] Initially, the motor vehicle 2 is in a geographical position, for example the user's home, that is off the road or highway networks of interest.

[0024] When, at step 300, the motor vehicle 2 is driven through a road barrier or gate provided with a detector 4, for example a gate of a highway toll station, the module 20 interacts (steps 305-306) according to known methods with the detector 4, exchanging data that allow the detector 4 to identify the electronic pass installed on board the motor vehicle 2, thanks to the unique identification code encoded in the memory 26. In step 306, the information related to the electronic pass 20, which is rigidly coupled to the motor vehicle 2 on which it is installed, is then sent over the data communications network 6 to the service center 50 and is stored within the database 51, whose records preferably contain at least the following fields: identifier of the electronic pass, identifier of the detector 4, time of transit. The database 52 contains information related to the current status of the road network managed by the system, for example the toll rates between the different sections, the weather conditions or the traffic situation.

[0025] When the data arriving from the detector 4 are received, the central system 50 is therefore capable of knowing the exact position of the motor vehicle 2 and of retrieving information specifically of interest to the driver.

[0026] In step 315, the system checks whether the received data relate to the passing of a barrier for exiting from the road section managed by the operator, in which case closure operations (step 320) described hereinafter are activated.

[0027] In step 325, therefore if the motor vehicle 2 has just passed an entry barrier, the service center 50 stores the data in the database 51 and sends in step 330 a notification message over the network 6; such message is received and decoded by the information pass by means of the codec 14. In step 335, the information pass displays said information on the display 29.

[0028] In step 340, during travel, the information pass module 10 receives via the interface 11 data that arrive from satellites 3. The information is appropriately decoded by the decoder 12 and converted by triangulation of the signal that arrives from at least three different satellites into digital data that identify the position of the motor vehicle 2.

[0029] Periodically, either automatically or on explicit request of the driver, such data can be encoded by the encoder 14 and transmitted by the transceiver 13 over the network 6 to the control center together with the identification data of the electronic pass 20, as shown schematically by the conditional block 345. If the delay between two successive automatic transmissions has expired or if there is an explicit command by the user, the data are actually sent to the service center (step 350), the control computer of which checks whether the received data are different with respect to the last data sent (step 355), particularly with reference to the date and time of the transmission, in which case it stores them in the database 51 in step 360. In this manner, the central system 50 is capable of knowing the exact position of the vehicle within the managed road network and of checking in the database 52 (step 370) for the presence of information that is potentially of interest to the driver of the motor vehicle 2, for example information related to weather conditions or traffic situations in the direction in which the vehicle is traveling; this can also comprise continuous updating information that arrives from external sources (step 385), relative to the direction taken by the vehicle.

[0030] Such direction can be calculated easily also starting from a review of the data already received: typically, analysis of the position of the motor vehicle in the last two received messages is sufficient to calculate both the direction of the car and its speed of travel, which can be obtained by way of a simple space/time ratio. The information related to speed, combined with the information related to the position of the vehicle, which might be for example temporarily located at a service station or off the traffic lane, allows to measure in real time queues or traffic slowdowns, by averaging the travel speed of the various vehicles in the area of transit.

[0031] If there is information of interest (step 380), the central system 50 encodes a message that is addressed with a conventional method and is intended for the motor vehicle 2 and for all the vehicles that are in a similar position, and sends it over the data communications network 6 (step 330). The module 10 again receives and decodes the message if it is addressed to it, by means of the interface 13 and the codec 14, and transmits said information to the module 20, which displays it on the display 28. Examples of these displays generated in step 370 are given by way of illustration in Figures 4b, 4c and 4d in the accompanying drawings. It should be noted that there is a wide variety of information useful for the driver that can be sent if the position of the vehicle along the road section is known, for example information indicating parking areas but also advertising information, tourist information, and so forth.

[0032] The cycle is then repeated until the vehicle passes through another barrier or in any case passes in the vicinity of a local detector 4. In this case, the flow resumes in step 300, until in step 315 the system understands that the vehicle has left the covered network and, as mentioned, performs the closure operations. These operations include conventional charging operations for payment for the road traveled and the sending of a message on the part of the central system and in the manner described above, which identifies the barrier that has been passed and the amount paid, as shown by way of example in Figure 4a by the lettering "ROMA NORD EUR 27".

[0033] In another embodiment, the memory means 24 and the processor 23 which can be located in the module 20, as shown in the figure, and in the module 10, or in both modules, are used for data processing, acquisition and storage operations.

[0034] In greater detail, the device 1 stores initially a predefined expected base speed for the route accessed by the vehicle. Said base speed is preferably set to the typical average highway speed of the vehicle on which the device is installed, and can also be modified remotely, upon receiving a message sent by the service center 50, which once the route has been identified thanks to the messages sent by the device 1 or by a detection device 4 in the manner already described, can send to the device 1 a new value of expected average speed.

[0035] The processor 23, on the basis of the data received by means of the satellite receiver, is capable of calculating at each instant the actual average speed of the vehicle, performing for example a simple space/time ratio. This average speed, compared with the expected average speed, allows the processor 23 to determine whether the vehicle is traveling at a speed that is equal to or higher than the typical average speed of the route, which indicates lack of traffic, or if on the contrary the speed of the motor vehicle is lower than the average expected speed, which is an indicator of heavy traffic or queues, particularly if the actual average speed drops to levels far lower than the expected average speed.

[0036] Several data identifying the current situation, such as for example the average speed of the vehicle 2, the position of the vehicle and the time, in addition to further data that can already determine whether the route has been covered at a speed that is lower or higher than the expected speed, are then stored inside the memory means 24. These data, typically at the end of the route, are sent in the manner already described to the service center 50, which therefore has a further opportunity to reconstruct the traffic situation along the route covered by the motor vehicle 2, combining the data received with data of the same type sent by other motor vehicles.

[0037] According to requirements, the device 1 can perform even more complex calculations and store additional information in order to correctly determine the speed of the vehicle. For example, the service center can send data related to the location of service stations, so that the processor 23 can discriminate, in case of a stop at one of said stations, the data related to the speed actually held by the vehicle in motion with respect to the speed held by the vehicle in the parking area.

[0038] Again with reference to the embodiment of the communications device shown in Figure 2, there is a control device 27, provided with a suitable keyboard, for communicating with the module 20. Such device, which is typically interfaced with an infrared or radiofrequency input port 25, to which a decoder 26 is connected, allows to perform several programmed operations within the module 20. A first operation is the already-mentioned transmission of the current position of the motor vehicle in manual mode, which corresponds to an implicit request for a traffic or weather conditions update. A second operation is to use the communications device 13-14 to make a telephone call over the mobile telephone network if a GSM network is being used, as shown for example in Figure 4e. Further operations are display control operations, for example in order to alternate the display of the information that arrives from the service center 50 with the information regarding the position of the vehicle as received by the module 10.

[0039] It has thus been shown that the present invention achieves the intended aim and objects. In particular, it has been shown that the described method and system allow to integrate efficiently data from different sources in order to provide detailed information which is most of all targeted to the various drivers. It has also been shown that the invention is practical to provide, since its implementation is an inventive integration based on individually commercially available electronic components.

[0040] Clearly, numerous modifications are evident and can be promptly performed by the person skilled in the art without abandoning the scope of the protection of the appended claims. For example, it is obvious for the person skilled in the art to use alternative networks or protocols to retrieve the information related to the position of the motor vehicle or to the remote communication, or to replace the described components with equivalent mechanical or electronic components, and it is obvious and within the scope of the appended claims to use the display or a portion of the display of a satellite navigation system instead of the dedicated display, according to requirements and to the technology made commercially available. It is also evident that the inventive concept on which the present invention is based is independent of the actual implementation of the illustrated modules, which can be provided in any shape and dimension. Therefore, the scope of the protection of the appended claims must not be limited by the illustrations or by the preferred embodiments presented in the description as examples, but rather the claims must comprise all the characteristics of patentable novelty that are within the present invention, including all the characteristics that would be treated as equivalent by the person skilled in the art.

[0041] The disclosures in Italian Patent Application No. MO2002A000362 from which this application claims priority are incorporated herein by reference.

[0042] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A data communications device for motor vehicles, **characterized in that** it comprises:

   - a locator unit that comprises a satellite signal receiver;
   - a receiver and a transmitter that operate in the mobile-telephone frequency range and with mobile-telephone protocols;
   - a local communications device, which comprises a short-range transceiver for communication with local electronic detectors;
   - a display for displaying information received over one or more of said receivers.

2. The data communications device for motor vehicles according to claim 1, **characterized in that** said satellite receiver is a GPS-type receiver.

3. The data communications device for motor vehicles according to claims 1 or 2, **characterized in that** said mobile-telephone frequency range and protocols are selected from the group that comprises GSM, GPRS and UMTS.

4. The data communications device for motor vehicles according to claims 1 or 3, **characterized in that** said short-range transceiver is a transceiver of the Telepass™ type.

5. The data communications device for motor vehicles according to claim 4, **characterized in that** said local sites comprise road toll stations.

6. The data communications device for motor vehicles according to any one of the preceding claims, further comprising a receiver for acquiring commands sent by a control device driven by a user.

7. The data communications device for motor vehicles according to any one of the preceding claims, **characterized in that** said control device is a keyboard.

8. The data communications device for motor vehicles according to one or more of the preceding claims, **characterized in that** it comprises a timer for periodically and automatically sending significant data regarding the vehicle on which the device is installed.

9. The data communications device for motor vehicles according to claim 7, **characterized in that** it comprises a control key for manually sending significant data related to the vehicle on which the device is installed.

10. The data communications device for motor vehicles according to claim 9, **characterized in that** significant data further comprise at least one of the following:

    - motor vehicle position;
    - motor vehicle speed;
    - data entered by the user.

11. The data communications device for motor vehicles according to one of the preceding claims, **characterized in that** it comprises:

    - means for calculating the average speed of said vehicle along a route;
    - means for comparing said speed with an expected speed;
    - means for storing data that identify said comparison.

12. The data communications device for motor vehicles according to claim 11, **characterized in that** said expected speed can be set remotely.

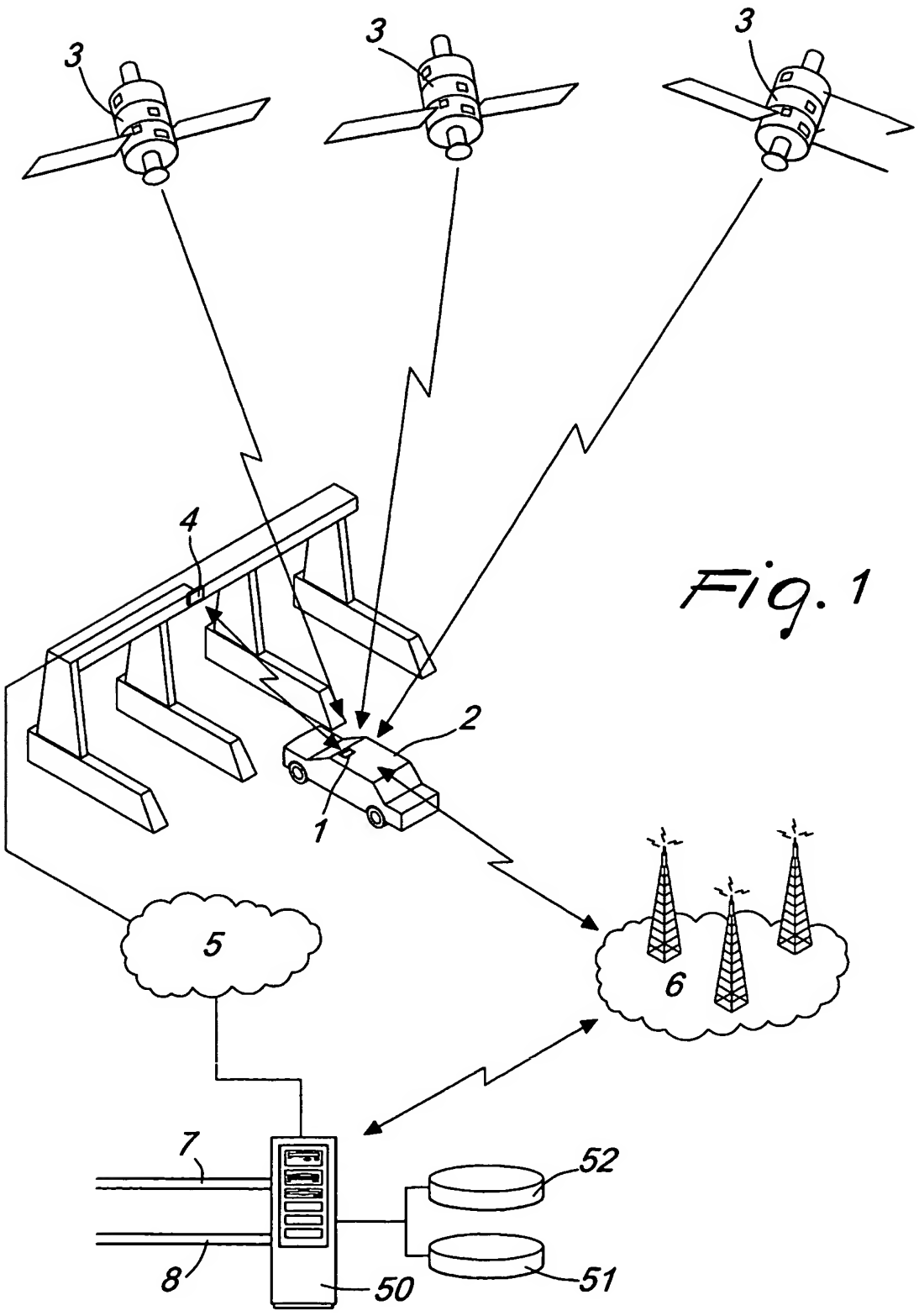


Fig. 1

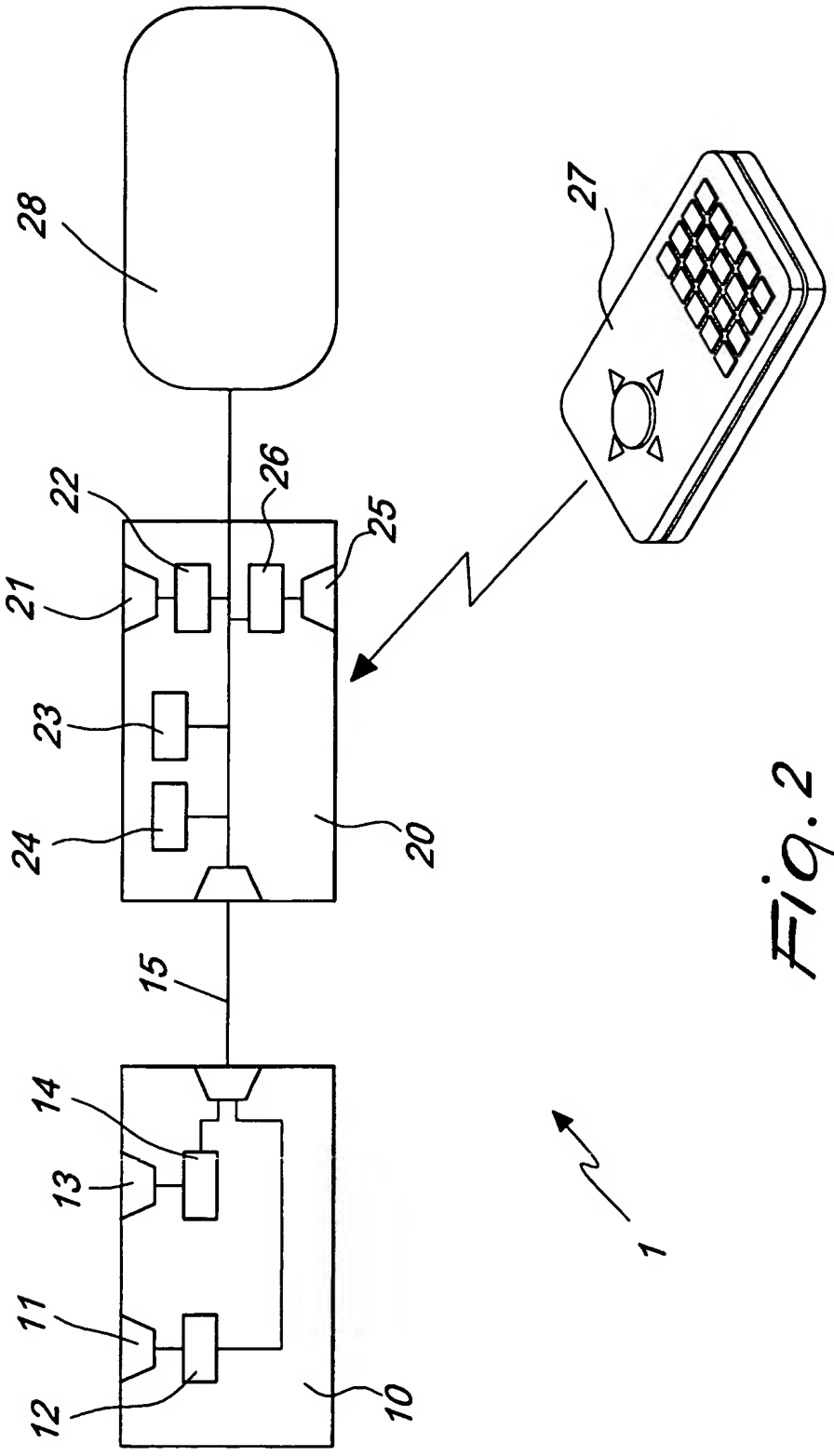
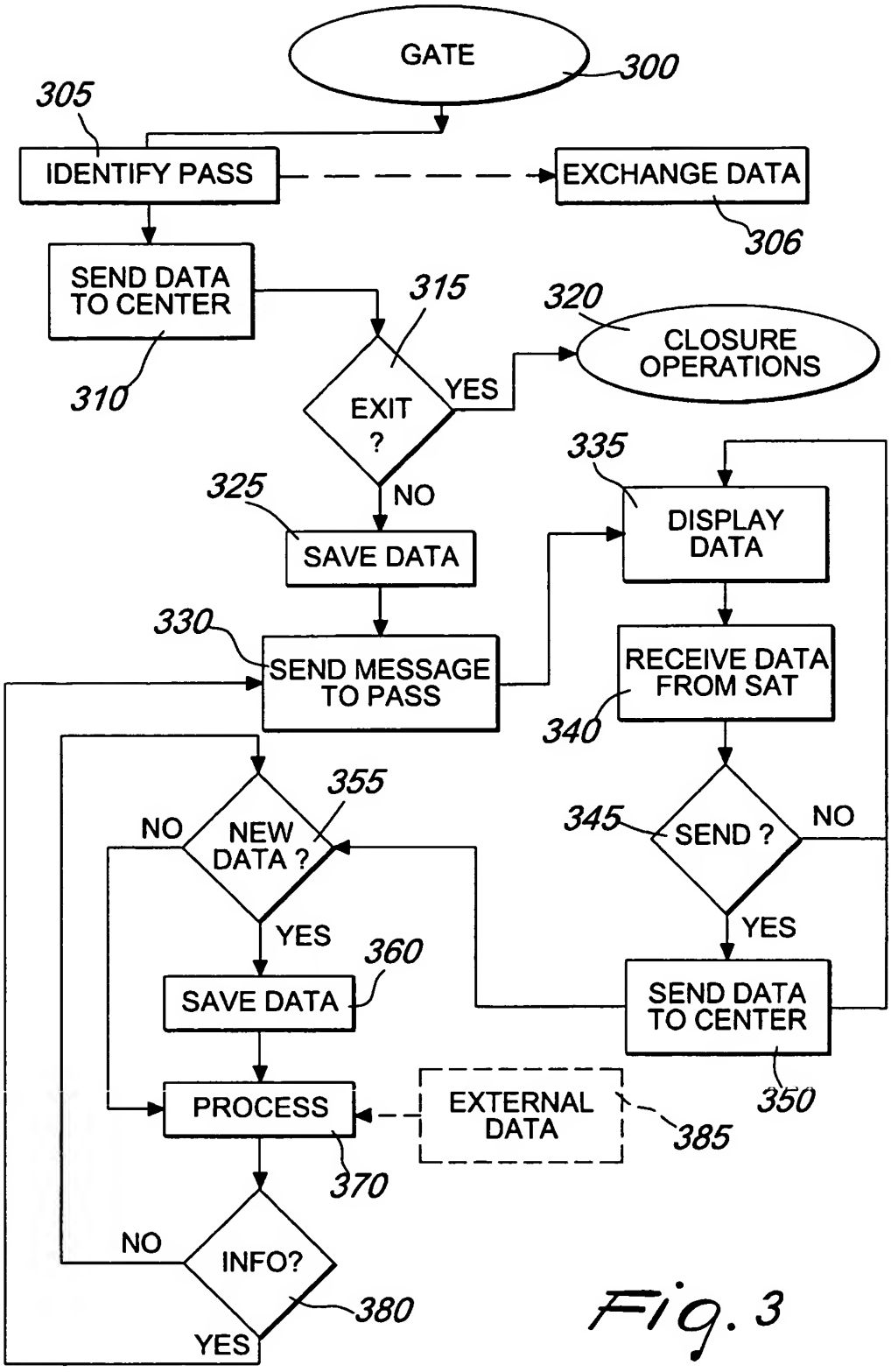


Fig. 2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305
IDENTIFY PASS
EXCHANGE DATA
306
SEND DATA TO CENTER
310
315
EXIT ?
YES
320
CLOSURE OPERATIONS
NO
325
SAVE DATA
330
SEND MESSAGE TO PASS
335
DISPLAY DATA
RECEIVE DATA FROM SAT
340
345
SEND ?
NO
YES
SEND DATA TO CENTER
350
355
NEW DATA ?
NO
YES
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SAVE DATA
PROCESS
EXTERNAL DATA
385
370
INFO?
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YES
380

Fig. 3

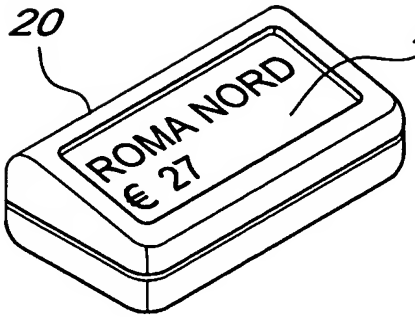

Fig. 4a

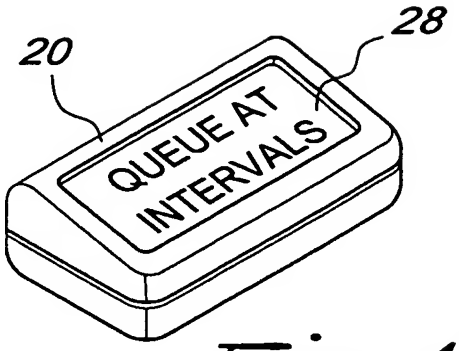

Fig. 4b

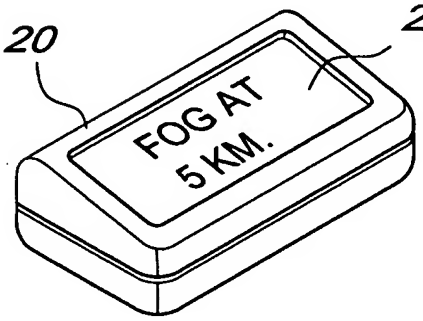

Fig. 4c

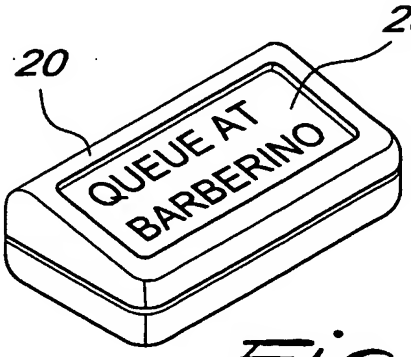

Fig. 4d

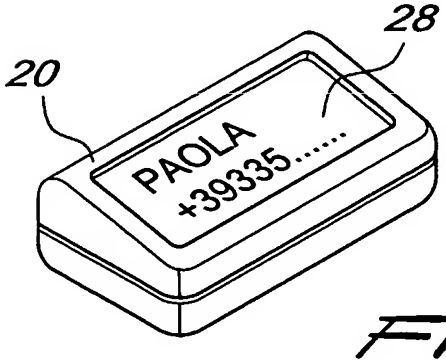

Fig. 4e

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 02 7456

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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Y	WO 00 45343 A (FEDERICI MARCELLO) 3 August 2000 (2000-08-03) * abstract * * page 1, line 28 - page 2, line 18 * * page 6, line 20 - page 7, line 6 * * page 7, line 34 - page 8, line 13 * * figures 1,2A,3 * ---	4,5,8-10	
Y	WO 01 11571 A (BARKER RONALD ;HERTLE JOCHEN (DE); MANNESMANN AG (DE); WIDL ANDREA) 15 February 2001 (2001-02-15) * abstract * * page 5, line 22 - line 24 * * page 7, line 5 - line 8 * -----	3	TECHNICAL FIELDS SEARCHED (Int.Cl.7) G08G G07B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	29 March 2004	Lupo, E

CATEGORY OF CITED DOCUMENTS

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